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DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

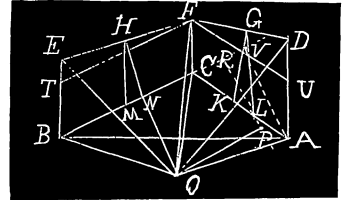
ARITHMETIC.

137. Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

At the corners of a triangle sides a, b, c feet, are towers d, e, f feet high. At what point must a ladder be placed so that it will just reach to the top of each tower without moving? How long is the ladder? Substitute $a=200, b=180, c=150, d=60, e=50, f=30$; d, e, f at A, B, C , respectively.

Solution by the PROPOSER.

Let ABC be the triangle, $AD=d, BE=e, CF=f$, the towers. Join DF, EF , and draw UF parallel to AC, TF parallel to BC . From G , the mid-point of DF , draw GK parallel to AD, GL perpendicular to DF . From H , the mid-point of EF , draw HM parallel to BE, HN parallel to EF . Draw ON perpendicular to BC , and OL perpendicular to AC . Then O is the required foot of the ladder. For O is equally distant from D, E, F , since OL is perpendicular to the plane $ADFC$ at L , and ON is perpendicular to the plane $BCFE$ at N . Draw LR, AV perpendicular to BC, OP perpendicular to LR .



Then $DU=d-f, EF=e-f, GK=\frac{1}{2}(d+f), HM=\frac{1}{2}(e+f)$.

In the similar triangles LGK and $DFU, LK:GK=DU:UF$.

$$\therefore LK = \frac{d^2 - f^2}{2b}, \quad CL = \frac{1}{2}b + \frac{d^2 - f^2}{2b} = \frac{b^2 + d^2 - f^2}{2b}.$$

$$\text{Similarly } MN = \frac{e^2 - f^2}{2a}, \quad CN = \frac{1}{2}a - \frac{e^2 - f^2}{2a} = \frac{a^2 + f^2 - e^2}{2a}.$$

$$AV = \frac{2\Delta}{a}, \text{ where } \Delta = \text{area } ABC. \quad VC = \sqrt{\frac{b^2 - 4\Delta^2}{a^2}}.$$

$$\therefore VC = \frac{a^2 + b^2 - c^2}{2a}. \quad RC:LC = VC:AC.$$

$$\therefore RC = \frac{(b^2 + d^2 - f^2)(a^2 + b^2 - c^2)}{4ab^2}.$$

$$RN = OP = RC + NC = \frac{(b^2 + d^2 - f^2)(a^2 + b^2 - c^2) + 2b^2(a^2 + f^2 - e^2)}{4ab^2}.$$

$$OL:OP = AC:AV.$$

$$\therefore OL = \frac{(b^2 + d^2 - f^2)(a^2 + b^2 - c^2) + 2b^2(a^2 + f^2 - e^2)}{8 \triangle b}.$$

$$OF = \sqrt{(OL^2 + CL^2 + CF^2)}.$$

When $a=200$, $b=180$, $c=150$, $d=60$, $e=50$, $f=30$,

$$OL^2 = 60363.9509, \quad CL^2 = 9506.25, \quad CF^2 = 900.$$

$$\therefore OF = 266.03 \text{ feet.}$$

Also solved by J. SCHEFFER.

136. Proposed by F. M. PRIEST, Mona House, St. Louis, Mo.

"A pound of gold may be drawn into a wire that would extend around the earth." What would be the diameter of such a wire if the specific gravity of gold is 19.36 and the distance is 24,900 miles?

Solution by J. M. ARNOLD, Crompton, R. I.; G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.; and J. SCHEFFER, A. M., Hagerstown, Md.

62.4 pounds = weight of 1 cubic foot of water. Then, the specific gravity of gold being 19.36, the weight of 1 cubic foot of gold is 19.36×62.4 pounds, or 1208.064 pounds.

Hence, in 1 pound of gold there are $\frac{1728}{1208.64}$ or 1.43039 cu inches nearly.

$$\therefore \frac{1}{4}\pi d^2 \times 24900 \times 5280 \times 12 = 1.43039 \text{ cubic inches.}$$

$$\therefore d = .000034 \text{ inches, nearly.}$$

Mr. Arnold remarks that to measure so small a quantity one would have to estimate 1-12 of one of the divisions of a Brown and Sharp's Micrometer Gage, which reads to the hundredth of a millimeter.

Also solved by ELMER SCHUYLER.

139. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College Mechanicsburg, Pa.

The ratio of the interest to the true discount on a certain principal for a certain time at a certain rate per cent. per annum, is $m=21$ to $n=20$. What is the rate per cent.?

Solution by P. S. BERG, B. Sc., Principal of Schools, Larimore, N. D.; and ELMER SCHUYLER, M. Sc., Professor of Mathematics, Boys' High School, Reading, Pa.

Let P be the principal; r , the rate; and t , the time in years.

Then the interest, I , is trP .

$$\text{The true discount} = \frac{trP}{1+rt}. \quad \therefore trP : \frac{trP}{1+rt} = m:n = 21:20.$$

$$\therefore 1+rt = m/n = \frac{21}{20}, \text{ and } rt = \frac{m-n}{n} = \frac{1}{20}, \text{ or } r = \frac{1}{20t}.$$

Thus r depends on the time.

If $t=1$ year, $r=5\%$.

Also solved by G. B. M. ZERR, J. M. ARNOLD, and J. SCHEFFER.